J Ethn Foods 3 (2016) 135–141

Contents lists available at ScienceDirect

Journal of Ethnic Foods

journal homepage: http://journalofethnicfoods.net

Original article

Revisit to Ethiopian traditional barley-based food

Jemal Mohammed, Semeneh Seleshi [1], Fetene Nega, Mooha Lee*

College of Agriculture and Environmental Science, Arsi University, Asella, Ethiopia

ARTICLE INFO

Article history:
Received 7 April 2016
Received in revised form
18 May 2016
Accepted 21 May 2016
Available online 8 June 2016

Keywords:
barley-based food
chuko
Ethiopian traditional food
functional food
genfo

ABSTRACT

Barley is the number one food crop in the highland parts of North Eastern Ethiopia produced by subsistence farmers grown as landraces. Barley producers in Ethiopia have given it the name *gebs ye ehil nigus*, which means barley is the king of crops, due to its suitability for preparing many of the known Ethiopians traditional dishes. Various barley foods and drinks play an important role in the socioeconomic and cultural life of Ethiopians, but detailed descriptions related to their preparation and their socioeconomic and cultural roles are not well-recorded and documented like most of the Ethiopian cultural foods. Foods such as *ingera*, *kita*, *dabo*, *kolo*, *genfo*, *beso*, *chuko*, *shamet*, *tihlo*, *kinch*, and *shorba* are the most commonly known traditional Ethiopian barley-based foods. These products are prepared from either roasted whole grain, raw and roasted-milled grain, or cracked grain as main, side, ceremonial, and recuperating dishes. The various barley-based traditional foods have perceived qualities and health benefits by the consumers. For example, *genfo* is served to breast-feeding mothers with the belief that it enhances breast milk production and serves as a good substitute for breast milk. *Beso* is claimed to be a remedy for gastritis, while *genfo* and *kinche* are used to heal broken bones and fractures. Considering the Western consumers' trend on functional foods and health benefits of barley, Ethiopian traditional barley-based foods are worth studying as functional foods, which can be appealing to Western consumers.

1. Introduction

Barley (*Hordeum vulgare* L. subsp. *vulgare*) is one of the earliest domesticated crops [1], with reports suggesting that it was domesticated more than 10,000 years ago in the Fertile Crescent of the Near East. It is the most widely grown crop over broad environmental conditions [2] than any other cereal from 70°N in Norway to 46°S in Chile. In addition, it is also cultivated higher on the mountain slopes than other cereals. In terms of area and production worldwide, barley is the fourth most important cereal after wheat, rice, and maize [3]. More than half of this barley growing area is in developing countries [4]. However, better quality products prepared from wheat and rice, compared with barley, decreased the use of barley as food, especially in the 19th and 20th centuries [5].

In Ethiopia, barley is among the oldest cultivated crops, and has been grown for at least 5,000 years [6]. It is grown in a wide agro-ecology of the country due to its economic and social importance. According to Kaso and Guben [2], barley is a staple food crop for many Ethiopians, especially for highlanders and it is also able to grow at all elevations, and cultivated by small holders in every region of Ethiopia. However, it performs best at the higher elevations in the northern and central regions of the country [2]. Ethiopian farmers store barley grains and seeds in a well-prepared underground pit to protect them from weevils and molds damage as well as from other physiological changes that cause loss of viability [7]. Barley grains can be stored for 5–25 years depending on the storage conditions, with dry and cold places being ideal for long-term storage [8].

Unlike the developed countries where barley is primarily used for animal feed, malting, and brewing, in developing countries like Ethiopia, it is produced mainly as a food crop. It is estimated that 90% of the produce is used for home consumption, of which about 10% is for local beverages [2]. Furthermore, barley is a popular hunger breaker or relief crop during periods of food shortage in some parts of Ethiopia as it is an early harvested crop and is also used as a substitute crop for wheat when wheat prices are high. Therefore, barley holds an important position in the food security of Ethiopia.

Foods are considered as the important identity for Ethiopians [9]. However, there hardly exists any recorded past recipes; instead,

* Corresponding author. College of Agriculture and Environmental Science, Arsi University, P.O. Box 193, Asella, Ethiopia.
E-mail address: michael81348@gmail.com (M. Lee).
[1] This author is currently on study leave at the College of Life and Environmental Science, Daegu University, Daegu, South Korea.

http://dx.doi.org/10.1016/j.jef.2016.06.001

the complex culinary art was handed down like a family heirloom from mothers to daughters. Their culinary art has for centuries been regarded as the quintessence of their cultural heritage. Although various barley foods and drinks play an important role in the socioeconomic and cultural life of Ethiopian farmers and urban dwellers [8], detailed descriptions on preparation of barley-based foods and their socioeconomic and cultural roles are not well recorded and documented like most of the Ethiopian cultural foods. At present, more than 20 types of traditional barley foods and beverages are described by farmers [7].

Therefore, this article has given a special attention to the processing of barley for the preparation of different Ethiopian traditional foods and reviewed them as the possible candidates of functional foods for Western consumers.

2. Production and contribution of barley to the livelihood of Ethiopians

Barley has another name, which is given by its producers and users in Ethiopia—*gebs ye ehil nigus*. The Ethiopian phrase means that barley is the king of crops due to its wide range of uses and to emphasize its suitability for preparing many of the known traditional dishes and beverages of Ethiopians [7]. Barley is the fifth most important cereal crop in Ethiopia after teff, maize, sorghum, and wheat [10].

The Ethiopian barley germ plasm has been important worldwide as a source of useful genes for traits such as disease resistance [11,12]. Under extreme marginal conditions of drought, frost, and poor soil fertility, barely is the most dependable cereal and is cultivated on highly degraded mountain slopes better than other cereal crops in the highland of Ethiopia [2]. The main barley producing regions in Ethiopia are Shewa, Arsi, Gojam, Gonder, Welo, Bale, and Tigray, where more than 85% of the country's total production comes from [10].

In Ethiopia, barley is used in many different recipes and deep rooted in the culture of people's diets [2]. In the highlands, it has been used for the preparation of various types of traditional foods such as *kolo*, *kita*, *dabo*, *beso*, *genfo*, *chuko*, *tihlo*, *shorba*, *kinche*, and *injera*, with *injera* being the most widely consumed traditional dish in Ethiopia [9]. Concerning the drinks, many alcoholic and nonalcoholic local beverages are brewed in households from barley grains for daily consumption or for holidays and celebrations [10]:

Fig. 1. (A). Soaked barley before dehulling. (B). Dehulling is performed using a wooden mortar and pestle. (C). Barley with bran during sun drying. (D). Roasting using an iron pan.

tella, *shamet*, and *korefe*, with *tella* [13] being the most commonly consumed alcoholic beverage in Ethiopia [2].

3. Ethiopian traditional barley grain processing methods for food preparation

3.1. Dehulling

To separate the bran from the grain, dehulling is a common practice followed for all types of Ethiopian barely-based foods. This process is performed by pounding the grain with a traditional wooden mortar and pestle. According to the anticipated type of the dish to prepare, dehulling of the grain from its bran is accomplished in one or two separation steps. The first step of dehulling is done after whole grains are soaked in water for few hours without any heat treatment. Soaking (Fig. 1A) helps to clean the grains from dust, as it removes any impurity by floating in the water while it also makes it easy to remove the bran from the grain. The moistened grain is then rubbed until the bran is removed from the grain by hitting/pounding the grain in a mortar with a pestle. The process is called *fitega* (Fig. 1B). Bran separation is done by drying the detached bran and grain together. It takes 2 days or 3 days depending on the intensity of the sunlight (Fig. 1C). For bran separation, wind velocity is the major facilitator, which is accomplished by vibrating and releasing the grain with its bran together from a certain height to a plastic or cloth (used for gathering bran and grain separately) kept on the floor. This process is known as *manifes*.

After this step, if the dehulled grain is further sun dried for few more days, it splits to become cracked grain. This cracked grain is used in the preparation of *kinche and shorba*. This cracking process is commonly performed using a special and traditional stone grinder [9,12] called *weficho*. By contrast, if the dehulled barley grain is ground into flour, it is used to prepare *injera*, *kita*, and *dabo*.

By following the first and the main dehulling process, the second step of dehulling is performed by mild hitting of the dehulled grain again, a process known as *shiksheka*. This step is important for further removal of the bran from the grain; it is performed after the application of heat treatment to the dehulled grain. The extent of heat treatment or roasting is used to determine the intended type of dish that is going to be prepared (Fig. 1D).

If the dehulled grain is sun dried, lightly roasted, and then milled, the flour is used for the preparation of *genfo.* These sun-drying and lightly roasting processes are used to increase the water-absorbing capacity of the flour obtained from barley grains [14], and during cooking, a high volume of *genfo* can be produced from a small amount of flour.

If the dehulled grain is deeply roasted and then dehulled for the second time, the roasted whole barley grain can be served as a small snack known as *kolo*. If it is milled, the flour is used for the preparation of *beso* and *chuko,* which are foods of roasted barely flour.

3.2. Cracking and milling

At present, in most towns of Ethiopia, the processes of cracking and milling of the dehulled grain are performed using a motorized mill but a traditional stone grinder (*weficho*) has been used for cracking since ancient times. A motorized mill is expected to grind finer than a manual mill, and therefore, the increase in surface area of finer particles possibly exposes the barley components more to deterioration. Furthermore, the flour is hotter because during milling of the grain using a motorized mill, the temperatures have been measured to reach up to 75°C [15]. The flour from the traditional stone grinder can be stored from 6 months to 10 years depending on the climate of the area, with the rate of deterioration increasing at high-temperature storage places [7]. Therefore, in terms of storage time, flour from traditional stone grinder is more preferable than flour from motorized mills.

4. Preparation of barley foods and their socioeconomic and cultural roles

In Ethiopia, barley-based foods are prepared as main, side, and ceremonial dishes (wedding and annual festivals). Sometimes they are primed as recuperating dishes and served to breast-feeding mothers with the belief that they enhance breast milk production. Besides, some dishes are claimed to be a remedy for gastritis, while others are reported to be a good substitute for breast milk or good to heal broken bones and fractures.

The major processes in the preparation of some traditional Ethiopian barley-based foods and the socioeconomic and cultural roles of these foods are described in the following sections.

4.1. Main dishes

Most of the Ethiopian main meals are *injera*, *kita,* and *dabo*. These foods are prepared from barley flour, which is obtained after milling, dehulling, and sun drying raw barley.

4.1.1. Injera

Injera is a thin and fermented Ethiopian traditional bread made from flour, water, and starter (*ersho*), which is a small portion from previously fermented dough [16]. It is the most widely consumed food because it accompanies almost all traditional dishes in Ethiopia, and is served with sauces [9].

Injera is prepared from flour of raw barley grain. Moderately fine-milled flour of barely is sieved and the dough is prepared. When the dough is prepared, the flour is mixed with water and kneaded by hand. A starter, leaven (*ersho*), is then added to the dough and left for 1–5 days to allow for fermentation to occur (in most cases, the mixture is allowed to ferment for 3 days). The duration needed for fermentation depends on altitude: the higher the altitude, the longer the fermentation time required, as the temperature would be lower [7]. *Injera* from well- and long-fermented dough makes a better sourer taste and has good storability.

During the preparation of *injera*, back-inoculation and addition of leaven for fermentation is a general practice commonly followed all over the country [8,15]. For fermentation, lactic acid bacteria and yeasts are the main fermentative microorganisms [17], and their products increase the acidity of the dough. Before baking *injera*, a small part of the dough is added to boiling water and the mixture is stirred until it starts to boil again and the whole mixture (called *absit*) is added to the *injera* dough. This ensures the dough undergoes suitable fermentation [7]. If necessary, more water is added and after half an hour baking can be started.

Injera is baked on a clay pan or *mitad.* Before baking, the pan is greased with kale or rape seed, and then heated and cleaned with a piece of cloth for better output. The dough mixture is put on the pan in a circular shape, forming a thin cake. The total baking time for one *injera* varies from 2 minutes and 30 seconds to 3 minutes and 30 seconds [7].

A good quality *injera* is soft, fluffy, and spongy with good and well-distributed *eyes* and it does not break when rolled. The major quality attribute of a good *injera* is its slightly sour taste, which is due to the acidic nature of *injera* [18]. Unfortunately, the *injera* storage period does not usually exceed 3 days at ambient temperature under the traditional storage conditions, mainly due to mold spoilage. There is a common practice to discard moldy *injera*.

However, during the time of food scarcity, moldy *injera* is sun dried and prepared for consumption.

4.1.2. Kita

Kita is a dry, thin, flat bread with a chew consistency similar to a chewy pretzel. It is an instant bread usually prepared for immediate consumption for children or as an emergency food when no *injera* or *kolo* is available. Sometimes by topping with sugar it is used to train children to eat properly [19]. Undeniably, if market bakery (*dabo*) is an object of desire, it is the focus of satisfaction that many Ethiopians aspire [9].

To make *kita*, the flour is mixed with water and kneaded by hand with a pinch of salt to make thick unfermented dough. It is then baked immediately on both sides using a clay pan (*mitad*) or iron pan (*biret-mitad*). When one side is baked enough, it is turned inside out, so as to allow the other side to bake. *Kita* is a relatively thicker and harder bread but smaller in size (about the size and thickness of a pizza base) compared with *injera*. It can be served either alone or with butter, milk, and linseed paste.

4.1.3. Dabo

Dabo is a leavened homemade bread, which is much thicker and softer than *kita*. The dough is prepared thick with salt added for an overnight fermentation. A leaven (*ersho*) is added as an initiator of fermentation, which is also the case with *injera*. *Dabo* or Ethiopians bread is baked on both sides by burning fire on both sides after covering the top with leaves and mud/clay. It is usually prepared for holidays or cultural gatherings.

In rural Ethiopia, toasted or baked barley *dabo* is another important element of the daily diet, something without which a meal would be incomplete [8], as it is the quintessential symbol of Ethiopian reciprocity and household hospitality.

4.2. Side dishes

4.2.1. Kolo

Kolo is the most widely consumed roasted whole barley grain in Ethiopia. During the preparation of *kolo*, the bran from the grain is separated using two consecutive dehulling steps: *fitega* and *shiksheka*. The whole grains of barley are first soaked in hot water for few hours, and then rubbed by beating/pounding the grain in a mortar with pestle (i.e., the *fitega* process). After the bran is removed from the grain by subsequent blowing, the grain is deeply roasted on iron/clay pans. Finally, the roasted grain is dehulled for the second time by mildly beating the grain with a mortar and pestle (i.e., the *shiksheka* process), or rubbed by hand to remove the remaining hulls.

This popular local snack, *kolo*, is consumed either alone or mixed with peanuts, field pea, faba bean, sunflower, and chickpea. It is usually consumed as a snack dish served before the main dish, and during coffee ceremony and other cultural occasions. As it is already known, coffee is the most common social drink that is shared with neighbors and at that time barley *kolo* (Fig. 2) is the most commonly served food [20].

Fig. 2. Barley *kolo*.

4.3. Ceremonial dishes

4.3.1. Genfo

Genfo is one of the most widely consumed foods in Ethiopia [19], and it is preferred as a main meal of breakfast, but most commonly consumed during a special celebration such as birthdays and weddings [8]. Traditionally, in many parts of Ethiopia, there is a habit to prepare *genfo* for an expectant mother. For this purpose, barley grain is the number one crop to choose. A postnatal mother eats *genfo* with spiced butter for breakfast and her guests are also served *genfo*. Neighbors and close relatives usually prepare barley *genfo* and give it to the new mother. In addition, *genfo* is also considered as an appropriate complementary food for children aged between 6 months and 24 months because it is thought to be important to make the baby grow faster and stay healthy [19].

Genfo (Fig. 3A) is prepared from the flour of roasted barley. When barley grain is prepared for *genfo*, sun drying takes a longer time, roasting is light, and milling is required. These sun-drying and roasting processes are used to gelatinize starch and to increase the water-absorbing capacity of the flour during cooking so that high-volume *genfo* can be obtained from a small amount of flour of gelatinized starch, which generally absorbs more water, and swells more than nongelatinized starch [14].

During the preparation of *genfo*, the lightly roasted grain is milled and sieved to remove the remaining hull. The flour is then added with some salt in boiled water and cooked with frequent stirring. *Genfo* is usually prepared with a recipe made up of glutinous ingredients like butter mixed with *berbere*, honey, or linseed paste [8]. This combination provides the lubrication, which allows the mouthfuls of thick porridge to slip down the throat [8]. A hole is prepared in the middle of the porridge, which is commonly used to put the lubricant. Porridge is most often served immediately when it is hot; there is also an Ethiopian proverb regarding serving porridge: “Porridge and love should be served hot, if cold, they will lose a lot.”

4.3.2. Beso and chuko

Beso and *chuko* are basically prepared from the same type of flour that is prepared from roasted barley. The preparation of the barley grain for *beso* and *chuko* flour is almost similar to the steps followed for the preparation of flour for *genfo*. The only difference arises from the level of roasting—flour from lightly roasted barley is used for *genfo*, whereas flour from intensely roasted barley is used for *beso* and *chuko*.

Beso is prepared using cold or hot water to moisten the flour on a bowl in such a way that it can be balled/rolled using hand and served (Fig. 3B). Salt is usually added in the water, but sugar or melted spiced butter can also be added, if available. *Beso* can also be prepared by mixing the flour with cold water and sugar, and served immediately in a cup or glass (Fig. 3C). According to most Ethiopians, *beso* cures gastritis.

Chuko (Fig. 3D) is one of the best traditional barley foods of Oromo people in Ethiopia. It is easy to prepare in a short span of time: first, barley is husked and then roasted over a fire. It is then pounded into powder. Over this roasted *beso* powder, different spices such as ginger, onion, salt, and sufficient amounts of spiced

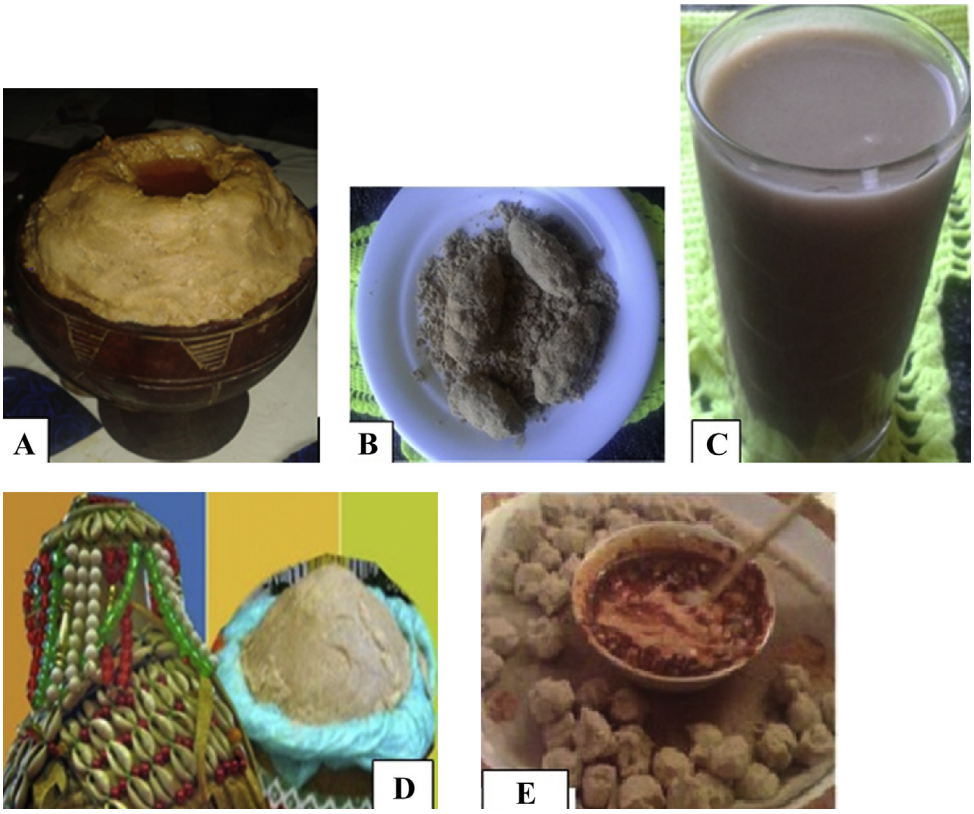

Fig. 3. (A) *Genfo*, (B) *beso* in solid form, (C) *beso* in liquid form, and (D) *chuko* with its traditional serving materials (gadaa.com/…/oromo-food-quiz-wedensday). (E) *Tihlo*.

and clarified butter (*ghee*) are added and mixed to create a tasty, chewy, and piquant finished product.

This dish is usually preferred as both a part of the everyday diet and prepared for special events or for postnatal women or a sick family member. *Chuko* is prepared for holidays and festivals. It is traditionally related to Oromo weddings, served by the bride's parents to the groom's best men. Furthermore, it is also popular among those on long journeys such as those leaving for education and for military campaigns, *zemecha*, because it can be stored for up to a year without spoiling. In general, *chuko* is mainly produced for home consumption sometimes as a variety dish, but can also be found at local markets.

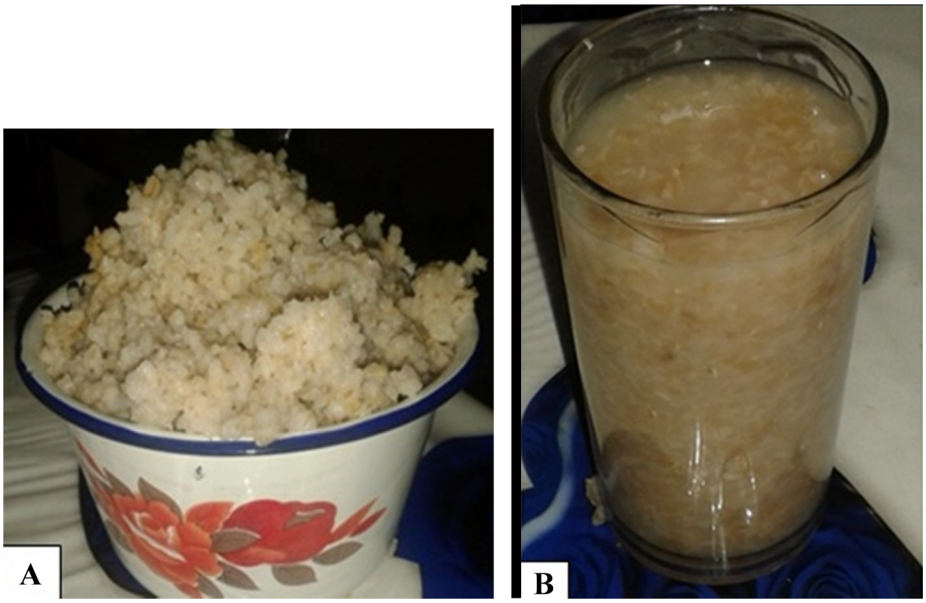

Fig. 4. Foods from cracked barley grain: (A) *kinche* and (B) *shorba*.

4.3.3. Tihlo

Tihlo (Fig. 3E) is commonly consumed as a side dish, especially by Tigray communities. The processing of barley for *tihlo* is similar to that followed for *beso* but the grain is completely dehulled and the milling requires extra care to avoid mixing with flours from other crops, which might decrease the quality. In addition, more water is used to prepare *tihlo* than *beso*. *Tihlo* is usually balled by hand and served with freshly made hot *shiro wot* (a sauce made from pulses flour and spices).

4.3.4. Kinche and shorba

For the preparation of *kinche* (Fig. 4A), the grain is dehulled using a mortar and pestle, roasted very lightly, cracked into four or five parts, sieved, and cooked in boiled water with occasional stirring to get a thick consistency. After adding salt and sugar, it is served when it becomes cold and, if available, spiced butter or ghee can also be added. *Kinche* is considered as a luxury food, and therefore prepared occasionally for changing diet and/or as an alternative dish when other dishes are not readily available.

The preparation of barley for soup, *shorba*, is the same as that of *kinche* except that more water is added to *shorba*. Thus, it is a drink served hot in a cup or using a spoon in a bowl. *Shorba* (Fig. 4B) can be mixed with some vegetables and pulses but it is usually served alone with sugar, salt, and spiced butter (if available). It is a very important dish during Ramadan, when it might be prepared daily.

5. Revisit to Ethiopian traditional barley dishes for functional foods

Throughout historical and archeological reports, barley is referred to as a source of health, strength, and stamina for athletes and manual laborers [21]. The health benefits and medical aspects of barley foods are referred to in ancient Arabic, Chinese, Egyptian, Ethiopian, and Greek literature [22]. Nowadays, people living in Western society are looking for healthier eating than ever. Scientific evidence has shown that there is a strong relationship between consumed foods and human health, and that there is a beneficial correlation between the function of various food components and the treatment and prevention of specific illnesses [23]. Therefore, consumer interest has focused on a diet with the capability to promote good health and to extend a healthy life span, and this promotes the development of functional foods. The global nutraceuticals/functional foods market expects to reach United States $204.8 billion by 2017 [24].

Among cereals, barley is the main cereal grain for the development of functional foods, as it contains β-glucan soluble fiber and antioxidants, vitamins (vitamins A and E, niacin, and folate), minerals (calcium, magnesium, phosphorus, and potassium), and phytonutrients such as phenolics and lignans, which can reduce the risk of coronary heart disease, cholesterol absorption, diabetes, and certain cancers. Barley products rich in indigestible carbohydrates (dietary fiber and resistant starch) facilitate glycemic regulation through a mechanism involving fermentation by gut microorganisms [25]. Because barley contains two classes of compounds of strong nutritional interest, namely, tocols (vitamin E) and β-glucans (soluble fiber), their health benefits have created a renewed interest in using it as a functional food. The United States Food and Drug Administration has issued a health benefit endorsement for barley based on β-glucan effects on lowering blood cholesterol and reducing the risk of heart disease [26]. The medical use of barley has been reported by Mohammad et al [27].

In cereal grains, tocopherols and β-tocotrienol are mainly concentrated in the germ, whereas hulls and endosperm have substantial concentration of other tocotrienols [28]. Tocols (tocopherols and tocotrienols) are well recognized for their biological effects, including antioxidant activity [29] and reduction of serum low-density lipoprotein-cholesterol [30]. The β-glucan polysaccharide family is the major constituent of barley endosperm cell walls and its viscosity-enhancing property may cause problems in brewing and reduce the value of barley as feed, but it has beneficial health effects on blood cholesterol level in animal and human trials [31] and on glycemic response [32].

Barley contains a high concentration, as well as a large range, of the nonstarch polysaccharide family members (1→3), (1→4). The hypothesized mechanisms for barley's hypocholesterolemic effect are as follows: (1) reduced absorption of dietary lipids including cholesterol; (2) reduced absorption of bile acids; and (3) production of volatile fatty acids in the large intestine that are reabsorbed, and act as inhibitors of β-hydroxy-β-methylglutaryl coenzyme A reductase in the liver [33].

In addition to the food values, the Ethiopian barley producers emphasized the medicinal properties and health benefits of the different dishes prepared from it. For example, *beso* is believed to be a remedy for gastritis. *Genfo* and *kinche* are believed to heal broken bones and damaged body parts. Besides, these dishes are considered smooth and easily digestible to serve to a sick person who cannot take another form of food for quick recovery. The tradition of preparing *genfo* for postnatal mothers is related to the benefit of barley in providing quick recovery from the effect of child birth. Some of the health benefit claims about barley foods by the consumers are believed to have scientific basis, which is well documented [34–39].

6. Conclusion

A larger proportion of Ethiopian barley crop is used for human consumption by producing different diets. For preparing barley for different food items, its grains are passed through various manual processing steps (i.e., dehulling, grinding, sieving, roasting), which are very tiresome and time consuming. During the manual processing and removal of the hull, there is wastage of some grains and it is also likely to have a negative effect on the nutritive value. It is important to investigate how Ethiopia can adapt to mechanizing many labor-intensive manual operations with simple utensils to maximize the benefits of barley as a food. Moreover, although various spices and sauces are also used with different barley dishes and these ingredients or additives are known to improve taste, no information is available on their effects on the nutritive values of each dish.

Considering the fact that the consumers in the advanced countries are getting more interested in functional foods, Ethiopian barley-based foods seem to have to be improved more in formulation. For example, among barley-based foods, *chuko* is one of the best barley-based foods, which is consumed by a majority of Oromo people in Ethiopia. It has not been commercialized and it is also becoming more difficult for many families to prepare due to the high price related to the large quantity of butter required. By contrast, the consumers of developed countries have tried to decrease the intake of animal fat. Accordingly, replacing butter by vegetable oils and adding more herbs and spices in the formulation will be a better option for the production of barley-based Ethiopian traditional dishes to satisfy the interest of Western consumers in functional foods.

Standardizing the ingredients use, modernizing the process technology, nutritional analysis, and packaging of the traditional foods may boost ethnic food tourism in Ethiopia, which could improve the country's economy. Through this effort, more Ethiopian traditional foods can be promoted to developed countries and it also could contribute more to the food security of the country.

Conflicts of interest

The authors have no conflicts of interest.

References

[1] Zohary D and Hopf M. Domestication of plants in the Old World: The origin and spread of cultivated plants in West Asia, Europe and the Nile Valley. 2nd ed. Oxford, UK: Oxford University Press Inc.; 1993.
[2] Kaso T and Guben G. Review of barley value chain management in Ethiopia. J Biol Agric Healthc 2015;5:84–97.
[3] Léon J. Genetic diversity and population differentiation analysis of Ethiopian barley (*Hordeum vulgare* L.) landraces using morphological traits and SSR markers [Internet]. 2010. Available from: http://hss.ulb.uni-bonn.de/2010/2158/2158.pdf.
[4] Grando S and Macpherson HG. Food barley: Importance, uses and local knowledge. In: Proceedings of the International Workshop on Food Barley Improvement, held in Hammamet, Tunisia, January 14–17, 2002. Aleppo (Syria): ICARDA; 2005.
[5] Newman CW and Newman RK. A brief history of barley foods. Cereal Foods World 2006;51:4–7.
[6] Harlan J. Ethiopia: a center of diversity. Econ Bot 1969;23:309–14.
[7] Shewayrga H and Sopade PA. Ethnobotany, diverse food uses, claimed health benefits and implications on conservation of barley landraces in North Eastern Ethiopia Highlands. J Ethnobiol Ethnomed 2011;7:19–34.
[8] Van Leur J, Gebre H, van Leur J and Gebre H. Landraces in the highlands of West Shewa, Ethiopia. Plant Genet Resour 2008;7:154–62.
[9] Kifleyesus A. The construction of Ethiopian national cuisine [Internet]. Asmara (Eritrea): University of Asmara; 2007. Available from: http://www.ethnorema.it/pdf/numero%202/ABBEBE%20KIFLEYESUS%20-%20The%20Construction%20of%20Ethiopian%20National%20Cuisine.pdf.
[10] Central Statistical Authority. Agricultural sample survey 2000/2001 (1993 E.C.) (September 2000–February 2001). Volume 1: Report on area and production of crops. Statistical Bulletin 245. Addis Ababa (Ethiopia): Central Statistical Authority; 2000.
[11] Bonman JM, Bockelman HE, Jackson LF and Steffenson BJ. Disease and insect resistance in cultivated barley accessions from the USDA national small grains collection. Crop Sci 2005;45:1271–80.
[12] Qualset CO. Sampling germ plasm in a centre of diversity: an example of disease resistance in Ethiopian barley. Crop genetic resources for today and tomorrow. In: Frankel OH and Hawkes JG, editors. Cambridge (UK): Cambridge University Press; 1975. p. 81–96.
[13] Sahle S and Gashe BA. The microbiology of tella fermentation. Ethiop J Sci 1991;14:81–92.
[14] Subrahmanyam SN and Hoseney RC. Shear thinning properties of sorghum starch. Cereal Chem 1995;72:7–10.
[15] Nishita KD and Bean MM. Grinding methods: their impact on rice flour properties. Cereal Chem 1982;59:46–9.
[16] Ashagrie Z and Abate D. Improvement of injera shelf life through the use of chemical preservatives. Afr J Nutr Agric 2012;12:6409–23.
[17] Yetneberk S, de Kock HL, Rooney LW and Taylor JRN. Effects of sorghum cultivar on injera quality. Cereal Chem 2004;81:314–21.
[18] Lakew B, Gebre H and Alemayehu F. Barley production and research. Barley research in Ethiopia: Past work and future prospects. In: van Leur J and Gebre H, editors. Proceedings of the First Barley Research Review Workshop. Addis Ababa (Ethiopia): IAR/ICARDA; 1996.
[19] Fekadu H. Mothers' infant and young child feeding practices and their determinants in Amhara and Oromia regions. A report on formative research findings and recommendations for social and behavior change communication programming in Ethiopia. Washington (DC): The U.S. Agency for International Development; 2014.
[20] Bhatty RS. Milling yield and flour quality of hulless barley. Cereal Foods World 1987;32:268–72.
[21] Malcolmson L. Barley for healthy eating [Internet]. Available from: http://gobarley.com/.
[22] Newman RK and Newman CW. Barley for food and health. Science, technology and products. Hoboken (NJ): John Wiley & Sons Inc.; 2008.
[23] Charkraborty R and Das L. Nutraceuticals and functional foods in human health and disease prevention. Boca Raton (FL): CRC Press; 2015. p. 61.
[24] Kinth P and Kankan N. Nutraceuticals and functional foods in human health and disease prevention. Boca Raton (FL): CRC Press; 2015. p. 3.
[25] Vasan A, Mani M and Boora P. Barley foods and health: Opportunities ahead. In: Proceedings of the 2014 International Conference on Intelligent Agriculture (IPCBEE), Vol 63. Singapore: IACST Press; 2014. p. 88–93.
[26] Food and Drug Administration. Food labelling: health claims; soluble fiber from certain foods and risk of coronary heart disease. Fed Regist 2008;73:9938–47.
[27] Mohammad AJ, Ali A, Russul HB, Mona A, Haider KZ and Mohammad AK. Characterization and antimicrobial activity of barley grain extract. Int J Curr Microbiol Appl Sci 2013;2:41–8.
[28] Peterson D. Barley tocols: effects of milling, malting and mashing. Cereal Chem 1994;71:42–4.
[29] Kamal-Eldin K and Appelqvist LA. The chemistry and antioxidant properties of tocopherols and tocotrienols. Lipids 1996;31:671–701.
[30] Wang L, Xue Q, Newman RK and Newman CW. Enrichment of tocopherol, tocotrienol, and oil in barley by milling and pearling. Cereal Chem 1993;70:499–501.
[31] Jahdav SJ, Lutz SE, Ghoparde VM and Salunkhe DK. Barley: Chemistry and value-added processing. Crit Rev Food Sci Nutr 1998;38:123–71.
[32] Kalra S and Jood S. Effect of dietary barley beta-glucan on cholesterol and lipoprotein fractions in rats. J Cereal Sci 2000;31:141–5.
[33] McIntosh GH and Oakenfull D. Possible health benefits from barley grain. Chemistry in Australia 1990;57:294–6.
[34] Ames NP and Rhymer CR. Issues surrounding health claims for barley. J Nutr 2008;138:1237S–43S.
[35] Bird AR, Vuaran MS, King RA, Noakes M, Keogh J, Morell MK and Topping DL. Wholegrain foods made from a novel high-amylose barley variety (Himalaya 292) improve indices of bowel health in human subjects. Br J Nutr 2008;99:1032–40.
[36] Panfili G, Fratianni A, Di Criscio T and Marconi E. Tocol and β-glucan levels in barley varieties and in pearling by-products. Food Chem 2008;107:84–91.
[37] Keenan JM, Goulson M, Shamliyan T, Knutson N, Kolberg L and Curry L. The effects of concentrated barley β-glucan on blood lipids in a population of hypercholesterolaemic men and women. Br J Nutr 2007;97:1162–8.
[38] Behall KM, Scholfield DJ and Hallfrisch J. Diets containing barley significantly reduce lipids in mildly hypercholesterolemic men and women. American J Clin Nutr 2004;80:1185–93.
[39] Hallfrisch J, Scholfield DJ and Behall KM. Blood pressure reduced by whole grain diet containing barley or whole wheat and brown rice in moderately hypercholesterolemic men. Nutr Res 2003;23:1631–42.